NON-PUBLIC?: N
ACCESSION #: 9401120063
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Clinton Power Station PAGE: 1 OF 5

DOCKET NUMBER: 05000461

TITLE: Manual SCRAM due to Decreasing Reactor Water Level Caused by High Rotor Thrust Trip of Only Available Reactor Feed Pump
EVENT DATE: 12/06/93 LER #: 93-006-00 REPORT DATE: 01/05/94

OTHER FACILITIES INVOLVED: None DOCKET NO: 05000

OPERATING MODE: 2 POWER LEVEL: 005

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: O. Villarreal, System Engineer TELEPHONE: (217) 935-8881 extension 3098
COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SD COMPONENT: V MANUFACTURER: F130
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

With the plant in STARTUP at about five percent reactor power, one turbine-driven reactor feed pump (TDRFP) uncoupled for an overspeed test and the motor-driven reactor feed pump (MDRFP) out of service to repair an oil leak, the only operating TDRFP tripped. Attempts to reset and restart the TDRFP were unsuccessful. Reactor water level dropped, and operators initiated a manual reactor SCRAM prior to the low reactor water level trip. Three groups of containment isolation valves received signals to close when water level dropped to the low reactor water level trip. Water level dropped to minus 19 inches on the wide-range level instrument before being restored. The most probable cause of the TDRFP trips were momentary rotor thrusts that activated the turbine thrust bearing wear detection trip system. Contributing to the cause of this event were operating the TDRFP at a continuous low-power/low-flow condition using high pressure steam, and continuing the plant startup

after taking the MDRFP out of service. Corrective actions include: a review of the event to identify possible improvements to the reliability of the thrust wear detection trip system; continued evaluation of the event and incorporation of the lessons learned into the appropriate procedures to provide guidance on operating the plant at low-power/low-flow conditions; and operator review of the event.

END OF ABSTRACT

DESCRIPTION OF EVENT

On December 5, 1993, the plant was in Mode 2 (STARTUP), the reactor was critical and preparations were underway to restart the plant after the fourth refueling outage (RF-4). The Motor-Driven MO! Reactor Feed Pump P! (MDRFP) SJ! was providing reactor feedwater flow. The "A" Turbine-Driven TRB! Reactor Feed Pump (TDRFP) was uncoupled due to maintenance during RF-4. At about 2000 hours, Main Control Room operators were notified of a severe oil leak on the MDRFP. Operators started the "B" 'TDRFP and shut down the MDRFP.

On December 6, 1993, the plant was at about five percent reactor RCT! power. The "A" TDRFP was still uncoupled and was undergoing overspeed trip testing. The "C" MDRFP was out of service for repair of the oil leak. The "B" TDRFP was in service and operating with its control provided by the feedwater startup level controller in the automatic mode.

At about 1941 hours, the "B" TDRFP tripped from a speed of about 2700 revolutions per minute (RPM) (TDRFP nominal speed is 4300-4400 rpm at 100 percent reactor power). At the time of the trip, the speed of the "A" TDRFP was increasing for the overspeed test and was about 200 to 300 RPM. In response to the trip, operators immediately placed the feedwater startup level controller in the manual mode to allow the "B" TDRFP trip hydraulics to be reset and the turbine to be brought back up to speed manually using the potentiometer. Between about 1941 and 1945 hours, the "B" TDRFP tripped six times as operators repeatedly reset the trip hydraulics and attempted to restart the TDRFP. The trips were occurring when TDRFP speed was between 1200 and 2550 RPM.

An area operator, who was observing the "A" TDRFP testing, and the Feedwater System SJ! engineer reported to the "B" TDRFP room and observed the turbine torque arm assembly responses to the repeated trip and reset cycles. No evidence of local problems with the "B" TDRFP were seen by these personnel while at the pump room.

Reactor vessel RPV! water level dropped about nineteen inches (on the narrow-range level instrument) while operators continued attempts to restart the "B" TDRFP.

At about 1945 hours, with RPV water level at about ten inches on the narrow-range level channel "B" instrument (Channel "B" is the lowest reading of the narrow-range level channels) and decreasing, operators placed the reactor mode switch HS! in the SHUTDOWN position to initiate a manual reactor SCRAM. RPV water level continued to decrease. When RPV water level reached 8.9 inches on the wide-range level instrument, the low reactor water level 3 alarm actuated, and containment isolation valves ISV! in Groups 2 (Residual Heat Rem System (RHR) BO! to upper containment pools), 3 (RHR shutdown cooling) and 20 (miscellaneous valves) received close signals.

After the level 3 alarm actuated, operators entered Emergency Operating Procedure (EOP)-1, "RPV Control," for control of reactor pressure and water level. All control rods were verified to be fully inserted.

The level transient progressed slowly, and reactor vessel water level was controlled using the Control Rod Drive system AA! for reactor water makeup. The Condensate Booster system SD! was available and could have been used to supplement reactor water makeup; however, it was not needed.

Because of the very low availability of decay heat, reactor pressure control was the main concern during the execution of EOP-1. This was of concern in order to control the reactor coolant cooldown rate within Technical Specification limits. At about 1948 hours, operators began removing steam loads to reduce the reactor cooldown rate. Main Steam SB! line drains and turbine TF! drains were removed first, followed by the Turbine Gland Seal Steam system TC! and the Steam Jet Air Ejectors (SJAE)SH!.

At about 1951 hours, reactor water level reached its lowest level, about minus nineteen inches on the wide-range level instrument, and slowly began increasing.

At about 2015 hours, operators closed the outboard main steam isolation valves to further control the reactor cool down rate.

At about 2016 hours, operators confirmed that all containment isolation valves in groups 2, 3, and 20 were closed by completing off-normal

procedure checklist CPS 4001.02C001, "Automatic Isolation Checklist."

At about 2030 hours, the plant was in stable condition with reactor water level above low reactor water level 3, and operators exited EOP-1.

During this event, the "A" Condensate Booster pump minimum flow valve V! 1CB011A did not automatically open as expected when the "B" TDRFP tripped; however, this failure did not adversely affect the event. Maintenance Work Request (MWR) D55788 was initiated to investigate and correct the cause for the failure.

Condition Report (CR) 1-93-12-010 was initiated to track the root cause evaluation and corrective action determination for this event. MWR D55799 was initiated to investigate and correct the reason for the "B" TDRFP tripping. The MDRFP oil leak was repaired in accordance with MWR D16676.

No other automatic or manually initiated safety system responses were necessary to place the plant in a safe and stable condition. No other equipment or components were inoperable at the start of this event to the extent that their inoperable condition contributed to this event.

CAUSE OF EVENT

At the time of the initial "B" TDRFP trip, the feedwater pump TROUBLE and TRIPPED window annunciators illuminated simultaneously in the Main Control Room. The only two conditions which can give a simultaneous TDRFP trouble and trip indication are activation of the TDRFP active and inactive thrust wear detector pressure switches PS!. These pressure switches are activated by a momentary rotor thrust which in turn activates the turbine thrust bearing wear detection system JK!. The cause of the momentary rotor thrust is unknown; however, concurrent overspeed testing of the "A" TDRFP may have been a contributing factor. Overspeed testing of the "A" TDRFP could have caused a sharp demand for steam at the same time the "B" TDRFP was demanding steam. This coincident demand for steam could cause an increased opening of the "B" TDRFP steam control valve V! resulting in a momentary TDRFP rotor thrust sufficient to activate the turbine thrust bearing wear detection system.

The Nuclear Station Engineering Department (NSED) developed a plan to investigate the "B" TDRFP trips which occurred after the initial trip. The investigation concluded that the most probable cause of the trips was a momentary rotor thrust that activated the turbine thrust bearing

wear detection system. The momentary rotor thrust could have been caused by operators attempting to manually bring the "B" TDRFP back up to speed rapidly. This event was recreated in the Clinton Power Station simulator, and the results of this recreation support the conclusion that the "B" TDRFP trips could have been caused by momentary rotor thrust which activated the turbine thrust bearing wear detection trip system. At the time of the initial and subsequent trips, the "B" TDRFP turbine was operating using the high pressure steam supply. This mode of operation does not provide the same level of stable control (demand and response) as the low pressure steam supply. Steam is admitted into the turbine in a more gradual manner using the low pressure steam supply since the supply is controlled by a five-poppet steam valve. The high pressure steam supply provides steam in a coarser manner because it is controlled by a single valve. This event was the first time a TDRFP was operated continuously using only the high pressure steam supply at low flows and low power levels. Under these operating conditions, the feedpump turbine is more likely to react to changes in demand in a more abrupt manner, causing a rapid change in thrust on the turbine.

Contributing to the cause of this event were the operation of the TDRFP at a continuous low-power/low-flow condition using the high pressure steam supply, and continuing the plant startup after the MDRFP was taken out of service. Plant operation at low power (approximately five percent reactor power) with low feedwater flow rates using a TDRFP is an infrequently experienced condition. This condition was entered into prior to this event as a result of the MDRFP being out of service for repairs.

CORRECTIVE ACTION
As an interim measure, IP implemented a temporary modification to defeat the thrust bearing trip during the plant startup following this event to allow Maintenance and NSED to monitor the system. However, the alarms for the

trip system were not affected by the temporary modification. No trip system alarms were received during the subsequent plant startup.

NSED will continue to review this event and the thrust bearing wear detection system to determine if improvements can be made to its reliability.

This event will be reviewed by reactor operators, assistant shift supervisors and shift supervisors through required reading of Condition Report 1-93-12-010.

Operations and NSED will continue to evaluate this event and incorporate the lessons learned into the appropriate procedures such that guidance will be provided on operating the plant under low-power/low-flow conditions.

ANALYSIS OF EVENT

This event is reportable under the provisions of 10CFR50.73 (a) (2) (iv) due to the manual initiation of the Reactor Protection System JC! (SCRAM) and the automatic actuation of containment isolation valves.

Assessment of the safety consequences and implications of this event identified that this event was not nuclear safety significant. This event is bounded by the Loss of Feedwater Flow transient discussed in Chapter 15 of the Updated Safety Analysis Report. This event was a minor transient with no unexpected or abnormal responses noted and was within the design basis of the plant. The capability of the plant to perform its intended safety functions and achieve and maintain a safe shutdown was not affected by this event.

ADDITIONAL INFORMATION

The "A" Condensate Booster pump minimum flow valve that did not automatically open as expected when the "B" TDRFP tripped, is a six-inch, air-operated globe valve, model number 657-ET-70, manufactured by the Fisher Controls Company.

A review of previous LERs identified that LER 92-001-00 discussed a trip of the "B" TDRFP due to a worn thrust bearing on the feedpump. An increased feedwater demand caused an increased thrust on the thrust bearing. The increased thrust, combined with a larger-than-specified thrust bearing clearance, was the suspected cause of the thrust bearing wear trip. In the event reported in this LER (LER 93-006-00), the thrust bearing clearances were checked and found acceptable.

For further information regarding this event, contact O. Villarreal, System Engineer, at (217) 935-8881, extension 3098.

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U-602226
L45-94(01-05)LP
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JSP-003-94
January 5, 1994

Docket No. 50-461 10CFR50.73

Document Control Desk
Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Clinton Power Station - Unit 1
Licensee Event Report No. 93-006-00

Dear Sir:

Please find enclosed Licensee Event Report No. 93-006-00: Manual SCRAM due to Decreasing Reactor Water Level Caused by High Rotor Thrust Trip of Only Available Reactor Feed Pump. This report is being submitted in accordance with the requirements of 10CFR50.73.

Sincerely yours,

J. S. Perry
Senior Vice President

RSF/scf

cc: NRC Clinton Licensing Project Manager
NRC Resident Office, V-690
Regional Administrator, Region III, USNRC
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